3.3.7 Weather - Winter Storms and Avalanche

3.3.7.1 Background

Winter storm hazards present one of the greatest threats to life of any hazard in Montana. Statistics on winter deaths are difficult to obtain, but nationwide there are on average 100 lives directly and indirectly lost to winter weather, more than lightning, hurricanes, or tornadoes. Winter storms are considered to be deceptive killers because most deaths are indirectly related to the storm. People die in traffic accidents on snow- or ice-covered roads, from hypothermia due to prolonged exposure to cold, and from heart attacks due to overexertion. About 70% of the winter storm-related deaths in the U.S. occur from people leaving motor vehicles and nearly 25% are from exposure to snow and cold during outdoor activities such as snow shoveling (NOAA, 2001).

Most Montana residents are readily prepared for snow storms each winter. Every community receives snow on an annual basis, so residents expect measurable snow several times each winter. Cold temperatures into the negative numbers are also common throughout the winter months. Major problems typically only occur during record snowfalls and extended periods of below zero temperatures. Rapid snowfall can overwhelm the plowing resources, making roadways impassable, and severely reduce visibility. Particularly heavy snows, early or late season snows, and ice events can damage infrastructure such as power lines, and block roads or damage structures with downed trees. Extended cold periods, especially when coupled with strong winds, can create dangerous situations for those outdoors or those without heat, such as in the case of a utility disruption.

Unlike tornadoes and severe thunderstorms, winter storms are generally slow in developing, often taking one to three days to mature. This does not in any way diminish their importance, nor their potential for causing loss of life and destruction. What it does mean is that the National Weather Service (NWS) is often able to provide advance notice of winter storms, in some cases, lead times of one to two days.

Photo 3.7-1 A deputy sheriff directs traffic around a crash in a blizzard along U.S. highway 2 near Columbia Falls on Jan. 27, 2004. Heavy snow to the east near Essex triggered avalanches that knocked cars on a freight train (Robin Loznak/The Daily Inter Lake – NWS, 2004).

A **blizzard** is a storm that has winds over 35 MPH with snow and blowing snow reducing visibility to near zero. Blizzards and other severe weather are common in Montana.

Some of the Montana winter weather statistics are listed below:

- The coldest time of the day in Montana usually occurs 1 hour after sunrise.
- Winter weather conditions can change very quickly in Montana. For example:
  - The greatest temperature change in 24 hours occurred in Loma on January 15, 1972. The temperature rose 103 degrees, from 54 degrees below zero to 49 degrees above zero. This is the world record for a 24—hour temperature change.
  - Great Falls went from -32°F to +15°F in 7 minutes, a national record.

- The coldest temperature ever recorded in Montana was -70°F at Rogers Pass north of Helena, on January 20, 1954. This is also a national record for the lower 48 states.
- The Five Coldest Places (with weather recording stations) in Montana are:
  (Location, County, Average Daily Low in Jan.)
  - Westby, Sheridan, -5.8°F
  - 10 miles north of Opheim, Valley, -3.3°F
  - 12 miles southeast of Opheim, Valley, -2.9°F
  - Redstone, Sheridan, -2.7°F
  - Culbertson, Roosevelt, -2.0°F
- The greatest recorded 24 hour snowfall of 48 inches occurred in May 1982, 7 miles south of Shonkin, Choteau County.
- During the winter of 1964-1965, Kings Hill totaled 426 inches of snow.

Source: NWS, 2004.

Avalanche: A mass of loosened snow, ice, and/or earth suddenly and swiftly sliding down a mountain. In practice, assumed to be a snow avalanche unless another term such as ice, rock, mud, etc is used. Synonymous with "*snow slide*".

Avalanches occur throughout the mountains of Montana and, to a limited extent, elsewhere in the state. Avalanche hazards most-directly threaten winter recreationists, homes and businesses in mountainous regions, and communication and transportation networks. Two of Montana's ski areas, Bridger Bowl and Big Sky, are respectively the second and fourth most avalanche-prone ski resorts in the entire United States.

Of the major avalanche hazards, the interruption of communications lines probably occurs most frequently. Places of highest hazard include ski areas, mountain passes, and other areas where transmission lines cross avalanche paths. In regions where important highways or railroads cross areas subject to frequent snow slides, losses resulting from blocked roads, buried railroad tracks, and destroyed bridges can reach into the millions of dollars.

The complex interaction of weather and terrain factors contributes to the location, size, and timing of avalanches. In the absence of detailed scientific observation, any accumulation of snow on a slope steeper than 20 degrees should be considered a potential avalanche hazard.

The most certain sign of avalanche hazard is avalanche activity. Usually when one slope is hazardous, many of the nearby slopes are also hazardous. The historical record shows numerous cases where rescue parties searching for avalanche victims themselves become victims of the same avalanche cycle.

3.3.7.2 History of Winter Storms and Avalanches in Montana

Severe winter storms are one of Montana's greatest hazards. Winter storms may be categorized as ice storms, heavy snowfall, or blizzards. These storms vary in size and intensity and may affect a small part of the state or several states at once. Aside from the initial consequences, such as threats to vulnerable populations, freezing pipes, and snow removal costs, there are many residual effects, such as agricultural considerations and potential flooding concerns (MDES, 2004c).

Photo 3.7-2. Highway 191 near Malta, December 28, 2003. The highway was closed for several days following the record snowfalls in northeastern Montana. Many drivers were stranded during the storm that created this snow drift. (National Weather Service, 2004, Glasgow).

Winter storms impact the entire state annually. In February 1996, unusually cold temperatures covered most of the state, but communities in the northeast portion were exposed to life-threatening wind chills. The cold temperatures ruptured a natural gas line in Choteau, compounding the life-threatening situation further. Later that year in November and December 1996, heavy snowfall and freezing rain caused power outages in western Montana and collapsed numerous buildings in the northwestern portion of the state.

Eastern Montana because a Presidentially Declared Disaster areas after suffering an ice storm and blizzard in November 2000. The storm knocked out power to many homes and businesses from Plentywood to Ekalaka. Some locations did not have power restored for several weeks. Total estimated damages were $3 million.

A major late season winter storm affected much of the Rocky Mountain Front in June 2002. Heavy snow feel for three days with snow accumulations ranging from 3 to 4 feet over the valleys, to 5 to 7 feet above 5000 feet. This snow had a very high moisture content, which caused 301 power poles to break, 232 power pole cross arms to snap off, 521 splices, and over 30 miles of destroyed power lines. The power was out to over 2,500 customers, some for several days. Roads were closed over the entire Rocky Mountain Front region for 2 days. The deep snow cover resulted in the loss of over 3,200 livestock. Property damage was estimated at $3.2 million. The storm was a federally declared disaster for flooding (see **Section 3.3.2, Table 3.3.2-3**).

Since 1993, NOAA's National Climatic Data Center (NCDC, 2004) has recorded property damages or fatalities in Montana related to winter storms in every year except 1999. During this time, **11 deaths and almost $28 million** in property damage has been documented (**Table 3.3.7-1**). On average, these storms cause approximately **$2.5 million** in property damages and **1 fatality** each year (NCDC, 2004). Because winter storms are a frequent occurrence in Montana, much of the property damage and injuries/fatalities associated with winter weather may be under reported.

Table 3.3.7-1 Summary of Winter Storm Losses in Montana (1993-2003)
Source: NCDC, 2004.

Type	Dates	Death	Injuries	Property Damage
Snow & Ice Events with Property Damage and/or Fatalities	1993-2003	11	3	$27,803,000

Another cause of winter storm related fatalities are avalanches. From 1985 to 2003, there were **41 avalanche fatalities** in Montana, representing more than 10% of the nationwide avalanche related deaths (**Figure 3.3.7-1**) (CGS, 2004). Most of these fatalities were recreationalists such as skiers, snowboarders, snowmobilers and climbers.

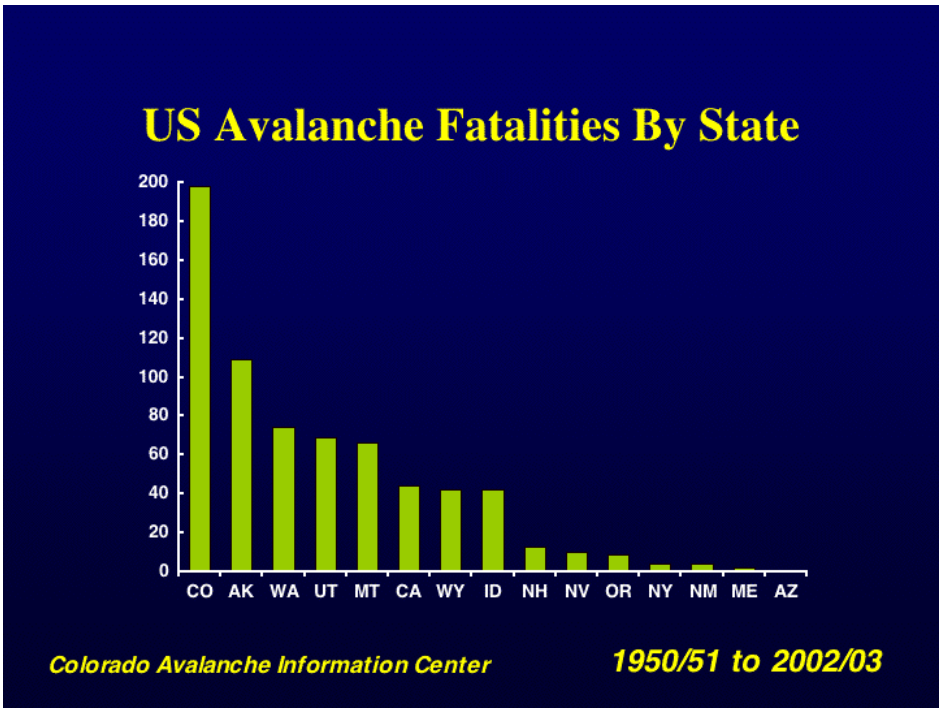

Figure 3.3.7-1 US Avalanche Fatalities by State. Source: CGS, 2004.

3.3.7.3 Declared Disasters from Winter Storms and Avalanches

Table 3.3.7-2 Federal Winter Storm Disaster Declarations in Montana, (1974 to 2004). Source: MDES, 2004a.

Date	Disaster No.	Type of Event	Areas Declared	Public Assistance ($)		
			Counties and Reservations	Federal	State	Local
November 2000	FEMA-1350-DR-MT	Winter Storm	Daniels, Dawson, Richland, Roosevelt & Sheridan	$2,049,746	$2,229	$681,019
April 2001	FEMA-1377-DR-MT	Winter Storm	Big Horn & Crow Reservation	$705,644	$439	$234,776
June 2001	FEMA-1385-DR-MT	Winter Storm	Gallatin, Missoula & Powell	$922,154	$18,938	$288,447
			TOTALS =	**$3,677,544**	**$21,606**	**$1,204,242**

Table 3.3.7-3 State Declared Winter Storm Disasters & Assistance in Montana.
Source: MDES, 2004a.

Year	PA or EO No.	Applicant	Local Share	State Share	Comment
1978	ST-78-1	Blaine County	$23,714	$117,620	Winter Storm
1978	ST-78-2	Havre, City of	$18,200	$19,495	Winter Storm
1978	ST-78-3	Phillips county	$22,085	$121,075	Winter Storm
1978	ST-78-4	Carter County	$14,135	$76,008	Winter Storm
1978	ST-78-5	Valley County	$29,681	$22,349	Winter Storm
1978	ST-78-6	Dawson County	$27,508	$31,524	Winter Storm
1978	ST-78-7	Garfield County	$41,484	$114,937	Winter Storm
1978	ST-78-8	Wibaux County	$18,728	$47,990	Winter Storm
1978	ST-78-9	McCone County	$19,117	$14,944	Winter Storm
1978	ST-78-10	Wolf Point, City of	$5,040	$10,231	Winter Storm
1979	ST-79-1	Judith Basin County	$17,320	$201,825	Winter Storm
1979	ST-79-2	Sweet Grass County	$10,174	$34,145	Winter Storm
1979	ST-79-3	Teton County	$24,210	$247,818	Winter Storm
1979	ST-79-4	Golden Valley County	$7,746	$66,693	Winter Storm
1979	ST-79-5	Carter County	$13,370	$95,672	Winter Storm
1979	ST-79-6	Garfield County	$13,800	$88,387	Winter Storm
1979	ST-79-7	McCone County	$21,680	$15,790	Winter Storm
1979	ST-79-8	Wibaux County	$15,650	$39,559	Winter Storm
1979	ST-79-9	Dawson County	$20,949	$75,947	Winter Storm
1985	MT-85-1	Neihart, Town of	$243	$12,542	Winter Freeze
1990	MT-2-90	Browning, Town of	$806	$2,493	Winter Storm
1996	EO2-96	Teton County	$0	$2,288	Winter Storm
1996	EO29-96	Glacier County	$0	$35,521	Winter Storm
1996	EO30-96	Libby, City of	$0	$74,645	Winter Storm
2004	EO 8-04	Petroleum County	$2,936	$11,282	Winter Storm
2004	EO 8-04	Daniels County	$9,373	$22,504	Winter Storm
2004	EO 8-04	Garfield County	$0	$31,389	Winter Storm
2004	EO 8-04	Richland County	$22,294	$45,162	Winter Storm
2004	EO 8-04	Roosevelt County	$43,444	$46,392	Winter Storm
2004	EO 8-04	Sheridan County	$12,575	$26,239	Winter Storm
2004	EO 8-04	12 Cities & Towns	$19,619	$66,713	Winter Storm
TOTAL			**$475,881**	**$1,819,179**	

3.3.7.4 Vulnerability to Winter Storms and Avalanches

3.3.7.4.1 Statewide Vulnerability to Winter Storms and Avalanches

The entire state is considered vulnerable to affects from heavy snowfall and subzero temperatures from winter storms. The winter weather patterns dictate exposure to the severest winter weather. Arctic cold fronts typically enter the state from the northeast and may cross the Continental Divide, affecting the western portion of the state. Arctic fronts meeting wet maritime fronts often combine to cause heavy snowfall, which can occur in all parts of the state. The lowest temperatures are typically experienced in the northeast, whereas the heaviest snowfall most often occurs in the mountain regions. Exposure does not equate to vulnerability, as preparedness and awareness in the most exposed portions of the state reduce vulnerability. For those reasons, the entire state is considered equally vulnerable to affects from winter storms.

The avalanche hazard is more localized in mountain regions. Avalanche-prone areas are well known; avalanche chutes identify where they will likely occur again. Where communities have built or developments have encroached into steep mountainous terrain, the vulnerability increases. Most of the exposure to the population is in winter recreation areas.

3.3.7.4.2 Review of Potential Losses in Local PDM Plans

Of the 6 counties that have completed Pre-Disaster Mitigation Plans, 5 identified winter storms as a hazard that could have a high impact on the population and could have a significant economic impact on the counties:

- Butte-Silver Bow County ranked winter storms as the second greatest hazard threat to the county.
- Daniels County identified winter storms as one of the 3 greatest hazards threatening the county. Winter storms have the greatest impact on population but the building stock and critical facilities are also vulnerable.
- Petroleum County identified severe winter storms as a hazard that could pose a significant threat to life and property in the county.
- Valley County identified winter storms as one of the 3 greatest hazards threatening the county. Winter storms have the greatest impact on population but the building stock and critical facilities are also vulnerable.
- Yellowstone County found the entire county could be impacted by winter storms. The frequency of storms contribute to the county's high vulnerability to winter storms.

3.3.7.4.3 Vulnerability of State Property

State property that may be vulnerable to winter storms includes property which may be flooded by frozen water pipes, or collapsed due to heavy snow loads. Unprotected water lines or water lines above frost lines in the ground could expose buildings to potential flood damage. The same applies to building structures that may not be structurally sound to withstand high snow loads. Inventories of potentially-exposed buildings that may have unprotected water lines or insufficient structural integrity were not found.

Table 3.3.7-4 shows the claims for losses related to extreme winter weather. Many of these losses are related to flooding from frozen pipes. Only one claim (Claim ID P-15920) was related to roof damage. The claim record was only available for the period of July 1, 1999 through June 10, 2004.

Table 3.3.7-4 Loss Claims for State Facilities Caused by Extreme Winter Weather

Claim ID	Agency	Location	Cause of Loss	Date of Loss	Request	Indemnity
P-12519	University System	Bozeman	Extreme Weather-Winter	12/10/2000	$3,000	
P-13159	University System	Billings	Extreme Weather-Winter	10/13/2001		$1,923
P-13921	University System	Billings	Extreme Weather-Winter	4/1/2002		$42,970
P-13949	University System	Bozeman	Extreme Weather-Winter	4/9/2002		$35,359
B-14896	University System	Bozeman	Extreme Weather-Winter	2/23/2003		$6,046
P-15720	University System	Bozeman	Extreme Weather-Winter	11/4/2003		$2,775
P-15880	University System	Bozeman	Extreme Weather-Winter	1/5/2004		$110,233
P-15886	Administration		Extreme Weather-Winter	1/6/2004		$1,761
P-16106	University System	Missoula	Extreme Weather-Winter	1/6/2004		$3,993
P-15889	University System	Butte	Extreme Weather-Winter	1/7/2004		$9,930
P-15901	University System	Havre	Extreme Weather-Winter	1/8/2004		
P-16215	University System	Missoula	Extreme Weather-Winter	1/9/2004		
P-15920	University System	Bozeman	Extreme Weather-Winter	1/13/2004		
P-15952	Health & Human Services		Extreme Weather-Winter	1/27/2004		

All parts of Montana are considered highly vulnerable to impacts from winter storms. All state-owned facilities will have equal exposure to winter storm hazards.

3.3.7.5 Winter Storms and Avalanche Data Limitations

Inventories of potentially-exposed buildings that may have unprotected water lines or insufficient structural integrity were not found. To evaluate State vulnerability, this type of evaluation would be needed, where buildings are geo-referenced and can be mapped digitally. To adequately evaluate avalanche hazards, the state buildings would need to be assessed with reference to slope and average annual snowfall. In addition, analysis of statewide avalanche hazard areas has not been conducted. Additional inventories of unprotected versus protected power lines were not available from the various providers.

3.3.7.6 Winter Storms and Avalanche References

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